

Response
Application No. 09/787,029
Attorney Docket No. 010294

REMARKS

Claims 1 and 15-24 are pending in the present application. By this Amendment, claims 1, 15, 16, 17, 19 and 20 have been amended. No new matter has been added. It is respectfully submitted that this Amendment is fully responsive to the Office Action dated October 5, 2006.

Allowable Subject Matter:

Applicant gratefully acknowledges the indication that claim 15 would be allowable if amended to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, discussed below, and to include all of the features of base claim 1, and that claims 16-24 as being dependent on claim 15, either directly or indirectly, would also be allowable once amended to overcome the rejection under 35 U.S.C. 112, second paragraph, and claim objections, as indicated on page 7 of the Action.

It is respectfully submitted that independent claim 15 has been amended from a dependent claim to a new independent claim. It is also submitted that new independent claim 15 and dependent claims 16, 17, 19 and 20 have each been amended to overcome their respective rejections under 35 U.S.C. 112, second paragraph, and claim objections. Accordingly, it is submitted that new independent claim 15 and its dependent claims 16-24 are now allowable.

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Claim Objections:

Claims 1, 15, 16 and 17 stand objected to for the specific reasons set forth in items 1-4 in pages 3 and 4 of the Action.

With regard to items 1 and 2, it is submitted that claims 1 and 15 have been amended overcome the respective claim objections.

With regard to item 3, it is believed that the Examiner meant to refer to claim 16 and not claim 10. As such, claim 16 has been amended to overcome the objection. In addition, claim 17 has also been amended to overcome the objections made in the last few lines of item 3.

With regard to item 4, it appears that the Examiner is incorrect, since while the last two lines of claims 16 and 17 are the same, the last two lines of claim 17 and claim 15 are not. Moreover, claim 17 does not depend from claim 16.

In view of the above, withdrawal of the claim objections is respectfully requested.

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35 USC 112, Second Paragraph, Rejection:

Claims 15-24 stand rejected under 35 USC 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

This rejection is respectfully traversed.

It is submitted that claims 15, 17, 19 and 20 have been amended to overcome this rejection. Accordingly, withdrawal of this rejection is respectfully requested.

As to the Merits:

As to the merits of this case, the Examiner relies on the newly cited reference of Phoenix et al. (WO 94/08409) in setting forth the following rejection.

Claim 1 stand rejected under 35 USC 103(a) as being unpatentable over Bennett (U.S. Patent No 5,307,410, of record) and Kahn (U.S. Patent No. 5,007,106, of record) in view of Phoenix et al.

This rejection is respectfully traversed.

Independent claim 1, as amended, now calls for *the quantum cipher communication system has two photoconductive diodes which detects said phase difference as a difference signal of said photoconductive diodes*. It is submitted that support for these amendments are provided by reference numerals 7a and 7b in Fig. 1.

The Examiner recognizes that Bennett discloses, “[t]he quantum cipher communication system has a detector which detects said phase difference as a difference signal of said detector (see col 7, lines 1-13).”¹

However, in the present invention, the quantum cipher communication system has two photoconductive diodes, and a phase difference is detected by the difference of signals from two photoconductive diodes.

Therefore, it is submitted that Bennett does not disclose the features of the claim 1 concerning *the quantum cipher communication system has two photoconductive diodes which detects said phase difference as a difference signal of said photoconductive diodes*.

The Examiner acknowledges on page 6 of the Action that the primary reference of Bennett does not explicitly disclose the last two features recited in claim 1 regarding:

¹ Please see, page 6, lines 8 -9 of the outstanding Action.

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wherein said difference signal is assigned to bit 0 or bit 1 by comparing said difference signal with threshold values which are determined from a quantum-mechanical probability distribution of said difference signals obtained from a plurality of said difference signal assigned bit 1 or bit 0.

wherein an eavesdropping is detected by said recipient measuring a change in said quantum-mechanical probability distribution of said difference signal, which is produced by the eavesdropping operation.

With regard to the first wherein clause noted above, the Examiner reiterates his reliance on the teachings of Kahn in col. 2, lines 61-col. 3, line 6 and asserts on page 3 of the Action that:

With regards to the limitation under contention, the examiner respectfully does not see how whether or not Kahn discloses how information is decoded is relevant to the limitation under contention. The passage cited by both the examiner and applicant shows bit 1 or bit 0 being represented by phase shifts, thus the passage appears to read on assigning bit 0 or bit 1 to a signal. Clarification by applicant is respectfully requested. Emphasis added.

Applicant respectfully acknowledges the examiner's request to explain how whether or not Kahn discloses how information is decoded is relevant to the limitation under contention, because the request is directly related to the very heart of the present invention. As the examiner points out, the passage cited by both the examiner and applicant shows bit 1 or bit 0 being represented by phase shifts. However, the recipient needs some apparatus and method to read the phase shift and to extract the bit values. The present invention discloses how to read the phase shift and extract the bit value when a signal light is so weak that its quantum mechanical fluctuation must be taken into account.

As Kahn discloses, homodyne detection offers high sensitivity for the single-bit decisions (col. 2, line 61 – col. 2, line 63), and the intensity modulation resulted from the interference between the local oscillator and signal can be employed to extract the data signal (col. 4, line 6 – col. 3, line 13). Figure 2A of the present invention shows the intensity modulation detected by the photoconductive diodes when quantum mechanical fluctuation is not taken into account, and this figure is the illustration of eqs. (3) and (4) of Kahn (col. 4, line 43 – col. 4, line 48). Figure 2B of the present invention shows the difference signal of two photoconductive diodes and it is the illustration of eq. (5) of Kahn (col. 4, line 63).

If quantum mechanical fluctuation is negligible as is the case of Kahn, the bit decision is straight forward, however the situation changes drastically when the signal light is so weak that its quantum mechanical fluctuation must be taken into account. Figure 3A (3C) of the present invention shows the probability distribution of the difference signal for binary-“1” (“0”) phase-shift, respectively, that can be experimentally determined from quantum mechanical probability distribution of the difference signal obtained from a plurality of the difference signal assigned bit 1 or bit 0. It is clear from these figures that two probability distributions overlap each other and a novel method is needed for bit decision. The present invention discloses a method in which the difference signal is assigned to bit 0 or bit 1 by comparing the difference signal with the threshold values which are determined from the probability distributions of the difference signal. Using the threshold method, the recipient can reduce his error rate, the security of quantum

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cipher communication system is enhanced. Applicant respectfully points out that Kahn fails to disclose or fairly suggest the usage of threshold values, and therefore Kahn does not disclose how information is decoded when the signal light is so weak that a change in said weak signal light's quantum mechanical state is detectable.

Therefore, it is respectfully submitted that Kahn fails to disclose the features of claim 1 concerning *wherein said phase difference is assigned to bit 0 or bit 1 by comparing said difference signal with threshold values which are determined from a quantum mechanical probability distribution of said difference signals obtained from a plurality of said difference signal assigned bit 1 or bit 0.*

With regard to the last wherein clause recited in claim 1, the Examiner relies on the disclosure in page 22, lines 4-20 and page 28, lines 6-19 of the newly cited reference of Phoenix. Please see, page 7, lines 2 and 3 of the Action.

That is, the Examiner states in page 7 of the Action that "Regarding item 2 (Wherein an eavesdropping is detected by said recipient measuring a change in said quantum-mechanical probability distribution of said difference signal, which is produced by the eavesdropping operation) which Bennett does not teach, the limitation is taught by Phoenix (p.22, lines 4-20, p.28, lines 6-19).

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However, according to p.22, lines 9-10 of Phoenix, it is described that:

“Alice and Bob will be able to detect this simply by counting the number of disagreements they obtain.”

In view of above disclosure, it is clear that Phoenix only discloses a method to detect Eve’s intrusion by counting the number of disagreements, and does not disclose the method to detect it by measuring a change of probability distribution of said difference signal. The probability that Phoenix refers to (p.22, line 15) is the probability of disagreement or agreement, and it has nothing to do with the probability distribution of the difference signal.

Also, according to p.28, lines 16-18 of Phoenix, it is described that:

“ $P(a,b)$ is the probability that Alice and Bob agree minus the probability that they disagree,”

In view of above disclosure, it is again clear that the probability that Phoenix refers is the probability of disagreement or agreement, and it is nothing to do with the probability distribution of the difference signal.

Therefore, it is respectfully submitted that Phoenix fails to disclose the features of claim 1 concerning *wherein an eavesdropping is detected by said recipient measuring a change in said*

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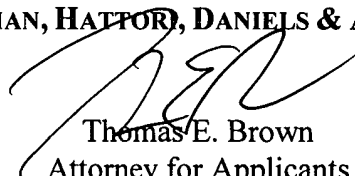
quantum-mechanical probability distribution of said difference signal, which is produced by the eavesdropping operation.

In view of the aforementioned amendments and accompanying remarks, Applicants submit that the claims, as herein amended, are in condition for allowance. Applicants request such action at an early date.

If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney to arrange for an interview to expedite the disposition of this case. If this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

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